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ABSTRACT

A questionnaire developed through analysis of the literature on the science career development needs of deaf students was completed by 20 individuals from the ranks of deaf scientists, science and industrial leaders, science educators of deaf students, career development specialists working with deaf students, staff of rehabilitation programs and services for deaf persons, members of community programs and supportive services for deaf persons, and representatives of educational programs training those who work with deaf students. When the needs statements from the survey were ranked, needs related to information about the world of work ranked as seven of the first eight needs statements. Additional needs identified by respondents fell in the categories of training programs for teachers of deaf students; basic skills instruction; information regarding the world of work; and sufficient support services, resources, and materials. The most highly endorsed need was for role models of deaf individuals currently employed in science related occupations. (The questionnaire is appended.) (CL)

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AN IDENTIFICATION OF THE SCIENCE CAREER DEVELOPMENT NEEDS OF DEAF STUDENTS

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November 1981

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Deaf students have some "special" educational needs that are different, at least in degree, from the education needs of other students. If the schools are to provide appropriate academic and career preparation for deaf students, their needs must be identified.

Some of the educational needs of deaf students have been examined in the past. For example, the vocabulary needs of the preschool deaf child were addressed by Miller (1954). Burroughs and Powell (1974) discussed the education needs of deaf children and how these needs vary among deaf students and Stewart (1971) projected the education, service, and rehabilitation needs of deaf persons during the 1970s.

With different needs, it appears that there are implications for the curriculum of the deaf child; however, as Moores (1978) points out

> very little has been done in the way of development of special curricula outside of language and speech training and auditory training. In other areas, especially those involving traditional academic subjects, the tendency is to rely on texts, courses of study, syllabi, and curricula designed for students with normal hearing. Sometimes the material is adapted without change, and sometimes it is modified - which typically involves a simplification of vocabulary used.... Because speech and language have been seen as the major need for deaf children, content areas such as mathematics, science, and social studies have received insufficient attention. Traditionally, because teachers of the deaf have been expected to be teachers of language and speech, even class time designed for academic subjects often has been devoted entirely to speech and language remediation. Since most teachers of the deaf have not been trained in specific areas, the tendency to sacrifice content is intensified.

The academic area of science is one which is most definitely neglected by teachers of deaf students. Menchel (1978) describes a "sad lack of science education for the deaf in the elementary and secondary schools." He visited twenty-four schools during the fall of 1977 and reported that only four had good science programs. He observed "poorly equipped 'laboratories,' outdated science books, no science courses until the eighth grade, no 'hands on' experiments, no laboratory periods, teachers who are not qualified to teach science and the stereotyped idea that science is too hard for the deaf student."

The American Association for the Advancement of Science (AAAS) conducted a survey in the fall of 1975 to ascertain the amount of science education handicapped students were getting. The AAAS survey reviewed the past and current curriculum guides for teaching science to deaf students and, as reported by Redden (1976), "where it is taught at all, science is presented as a way to solve specific life problems of health and safety. Science concepts, laws, and processes as well as attitudes of curiosity and problem-solving are usually ignored." In the elementary grades today, many children are introduced to the scientific method of problem solving and they learn the vocabulary that allows the understanding of scientific concepts. It would seem that without this background, it would be extremely difficult to achieve success at the secondary level and beyond.

AAAS also surveyed residential schools for the deaf and, as described by Redden, "efforts are being made to improve science education for the 'college-bound' student...high school students in residential facilities

receive a better science education than those in the 'mainstream' of education or in special classes in public schools...[however;] the general opinion of the science educators at the residential schools is that their secondary programs are far from adequate, and their elementary programs are all but nonexistent."

There is also a dearth of literature with regard to science education strategies for use with deaf students. Anselmini (1967) described the importance of carefully sequenced topics in which new material is related to previously learned material. Owsley (1962) and Lang (1973), as well as Anselmini, emphasize the importance of "hands-on" experiences and the use of mediated materials. Lang focused on the success of individualization of instruction for deaf students and in a 1979 paper, he presented suggestions for "mainstream" physics teachers who might have a deaf student in the classroom. Leitman (1968) and Cohen (1967) also suggested increased attention to the individual needs of deaf students in science classrooms. Fitzgerald (1968) called for flexibility in teaching facilities and class schedules, and the use of instructional materials as important factors in a successful science curriculum for deaf students.

As can be expected, the lack of quality science education programs and science education strategies for deaf students creates a situation that rarely allows the deaf student to choose science as a possible career. However, there are also several other factors related to deafness which tend to create career development problems for deaf individuals.

Hoeman (1965) cited three factors which have received considerable attention from psychologists. The "(1) lack of information on the world

of work, (2) lack of insight regarding interests and abilities, and (3) personality problems which may accompany the handicap of deafness."

Clarcq, Speegle, and Johnson (1973) describe how the acquisition and compilation of information are disrupted, resulting in a breakdown in the normal career development process due to the fact that many avenues of communication are not accessible to the deaf individual. Similarly, McHugh (1975) relates that the hearing impaired individual cannot compile "career information necessary for vocational maturity" as casually or as fully as a hearing individual.

Deaf students are "culturally isolated," (Menchel, 1980) isolation not in a physical sense, but caused by the lack of communication between people on which is based information used to structure personal goals and objectives. Galloway (1979) makes a comparison when he describes the hearing child as being constantly exposed "to the 'values of a work-oriented society' and thus [becoming] aware of the problems and rewards inherent in a wide variety of occupations."

Jencks (1979), not referring to deaf individuals, hypothesizes that attitudes, values, and behavior have a strong impact on occupational success. Wyks (1980), however, describes the deaf student as often "lacking in the attitudes and skills which will be the foundation for future occupational success."

In addition to the factors described above, it is important to note that "an emphasis upon the school-job relationship has always been considered within the domain of the technical or vocational school" that a deaf child might attend (Noretsky & Beach, 1980). Also,

historically, there has been underemployment and underutilization of the deaf in the U.S. labor market (Schein & Delk, 1974).

Deprived of quality science education and career development opportunities, few deaf students select a career in science. The identification of the science career development needs of deaf students would provide a basis for science and/or career development programs for deaf students.

REVIEW OF THE LITERATURE

Any consideration of the science career development needs of deaf students must be based on a systematic review of the literature regarding the status of science education for deaf students and the status of career education and career development for deaf students.

The Status of Science Education for Deaf Students

It is ironic that while science and technology have benefitted deaf persons in practically all facets of their lives, reciprocation has been minimal. Advances in hearing aid technology, telecommunication devices, and television captioning, for example, have provided more comfortable leisure time for hearing-impaired consumers. Similarly, applications of electronics and computer technology have played important roles in facilitating the integration of deaf individuals into academic and employment environments. Yet, despite these roles, science has been a neglected area of the curriculum in contemporary school programs serving deaf students. As a consequence, it comes as no surprise that the number of hearing-impaired high school graduates pursuing scientific and technical careers is extremely small.

Over one hundred fifty years have transpired since the first school programs were established for deaf children in the United States. A review of periodicals regarding the education of deaf students through these years, however, reveals a dearth of literature on science teaching that has been paralleled by the absence of science as an integral component

of the deaf student's school curriculum. In fact, it was not until this past decade that any significant effort had been taken to rectify this situation.

As mentioned, the literature on educating deaf students has been virtually devoid of articles on science teaching until recent years. One of the earliest published articles on the subject was a simple attempt by Ekstrom (1956) to encourage science teaching in the lower grades. A few years later, Owsley (1962) repeated this plea. He wrote that the deaf child's inherent curiosity cannot wait to be satisfied and that it is not enough to be told that the "book says so." The deaf child must discover on his or her own some of the elementary wonderments of the fascinating world of science.

Owsley's plea for enhanced science learning opportunities was one of several isolated attempts during the early sixties. More extensive efforts to upgrade science in the curriculum of residential school programs were made in the latter half of the decade when a number of articles and a book were published by the Volta Bureau. Anselmini (1967), in describing a junior high school science curriculum for deaf students, emphasized individual laboratory lessons, hands-on experiences, utilization of media, and planning a careful sequence of science topics. He recommended that the topics should not only provide an understanding of facts and skills, but should give the deaf student a background for future course work. Anselmini also stressed the importance of correlating the development of language, reading, speech, and lipreading skills with science instruction.

Leitman (1968) wrote that the many hours spent by the deaf child in formal instruction tend to foster a passivity which runs counter to the child's need to explore his or her world. Historically, educators of the deaf have tended to place a premium on immobility; however, there is some evidence that this is beginning to change. The literature appears to reflect the general consensus that deaf children are more successful in science programs that involve individualization, self-initiated discovery, and exploratory learning experiences. The importance of these general pedagogical strategies and curriculum development recommendations has been reiterated in different ways again by Owsley (1968) as well as by Cohen (1967), Fitzgerald (1968), Lang (1973), and Egelston and Mercaldo (1975).

Only a few references can be found in the literature which illustrate efforts by teachers of the deaf to apply the curriculum materials developed during the late sixties and early seventies for children with normal hearing under the auspices of the National Science Foundation. Alexander (1970), Cunningham (1971), and Dietz and Ridley (1975) described the usefulness of Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS), and Science as Process Approach (SAPA) materials, respectively. Grant (1975) attempted to adopt the Biological Science Curriculum Study (BSCS) units originally developed for the mentally retarded for use with low-verbal deaf students.

Despite their encouragement, the use of such materials remains minimal to date. Lang and Propp (1981) have shown that although these curriculum projects have been demonstrated to be successful with hearing

students, the primary reason they are not used extensively in the education of deaf students appears to be that many teachers of the deaf are simply not aware of the existence of such materials. Inadequate training and information dissemination techniques in the education of the deaf are largely the problem and it is most severe at the intermediate and secondary levels. Use of such inquiry-based materials as the BSCS, CHEM-Study, and Physical Science Study Committee (PSSC) is much lower in schools for the deaf than in programs for hearing students.

With the passage of Public Law 94-142, the Education for All Handicapped Children Act of 1975, there has been an enhancement of educational opportunities for many deaf students. In particular, the law has served as a catalyst for educational research, curriculum development, and promotion of active involvement and change in the professional organizations concerned with science education. Probably in no other academic discipline has such a rapid and positive reaction to PL 94-142 swept through the ranks of educators and other professionals as it has in science. This significant movement has been a turning point in the history of science education for deaf students and a description of some relevant activities demonstrates the extent of professional commitment and possible long-range effects on science education for deaf students.

In 1973, the Board of Directors of the American Association for the Advancement of Science (AAAS) established the Office of Opportunities in Science. The Project on the Handicapped in Science was launched in 1975 and has published and disseminated a voluminous amount of information

on science and the handicapped. Recent AAAS national conventions have included a number of sessions pertaining to careers in science for handicapped persons.

Other professional organizations such as the Association for the Education of Teachers in Science (AETS), the American Association of Physics Teachers (AAPT), and the American Chemical Society (ACS) have also offered special sessions, colloquia, or publications on handicapped students in science. A Northeast Regional Meeting of the AETS a few years ago offered a presentation describing the major components of a course for sensitizing science teachers to the needs of handicapped learners (Lang & Egelston-Dodd, 1979). An AAPT Symposium on the Disabled in Physics in 1979 included presentations by physics teachers from several colleges and universities who were themselves deaf or taught deaf students. The American Chemical Society devoted a major part of an issue of The Journal of Chemical Education to ten articles on teaching handicapped students in chemistry (March 1981). The 1980 ACS convention was held at the National Technical Institute for the Deaf at the Rochester Institute of Technology. Several sessions pertaining to teaching physically handicapped persons in chemistry were offered.

New organizations have been established over the past few years to facilitate participation of handicapped students and professionals in science. The Foundation for Science and the Handicapped is an organization of several hundred successful handicapped scientists who offer their skills to help solve problems related to the handicapped. The Foundation is associated with the AAAS. The Science for the Handicapped Association

focuses its efforts primarily on dimensions of science curriculum and teaching and offers an excellent bibliography of articles and research reports dealing with science for children with hearing, vision, or orthopedic impairments. This group of about one thousand members is associated with the National Science Teachers Association.

In 1978, the National Science Teachers Association conducted a three-day Working Conference on Science for the Handicapped in Washington, D.C. During this conference, educators presented papers on aspects of science education for deaf students (as well as blind and orthopedically handicapped students). These papers and discussion sessions were summarized in Science Education for Handicapped Students (Hofman, 1978). Participants in the NSTA Working Conference on Science Education for Handicapped Students identified several major thrusts toward improving the quality of science instruction for handicapped students. For deaf students these included: 1) the development of technical signs for specific science vocabulary; 2) adaptation of currently available science curriculum materials to meet the experiential and linguistic needs of deaf children; and 3) increased involvement of deaf science teachers working with hearing impaired students.

As one illustration of the positive results of this working conference, selected signs for science instruction have been collected by faculty at the Kendall Demonstration Elementary School. The manual includes suggestions for activities using the illustrated signs (Burch, 1978). Caccamise, et al (1978), described another project which involves the collection, evaluation and dissemination of technical signs on a much broader scale.

Included in this project are signs for secondary and post-secondary level chemistry, biology, and physics terms. A general overview of communication with deaf science students is provided by Lang and Caccamise (1980).

The National Education Association has published a textbook titled Teaching Handicapped Students Science. This book includes chapters on pedagogical methods, evaluation strategies, and science career development activities for handicapped students, including the deaf.

The effects of PL 94-142 and the ensuing "mainstreaming" movement in the field of science education are clearly apparent in the increase of published articles after 1976 on teaching deaf students. Hadary (1978) described an interdisciplinary approach in teaching laboratory science and art to deaf and other handicapped students. The development and modification of science curriculum materials for mainstreamed deaf students has also been discussed by Stolte (1978), Lang (1978), and Borron (1978).

When developing such materials, the determinants, concommitants, and effects of deafness all play significant roles. The effects of hearing loss on language performance, for example, and the lag behind normal hearing peers which results as a consequence of the auditory deprivation has been discussed by many (Davis, 1977; Moores, 1978; etc.) Although educators of the deaf have appealed for an emphasis on science as a means for cognitive development and for the development of language skills (Owsley, 1968; Leitman, 1968; Bybee & Hendricks, 1972; Egelston

& Mercaldo, 1975), science has continuously received low priority. Many teachers view speech and language as isolated, major needs. Few see science as a vehicle for developing communication skills.

While Furth (1966), Piaget (1974), and others believe that cognitive development is manifested without language, language may aid in the internalization that occurs when a child interacts with objects in the environment. Learning to classify, order, match, and sort, for example, all prerequisites to learning measurement concepts, occur through the interaction between the child and objects in the environment (e.g., through structured or unstructured play activities).

Boyd and George (1973) have hypothesized that restricted experiential deprivation is more to blame than language deficiency for the lag in abstract thinking of hearing-impaired children. Their investigation illustrated the importance of classification and physical manipulation of objects on the conceptual categorization skills of hearing-impaired children.

Moores (1978) writes that even with the many implications for specific curriculum development for deaf students, very little has been done in the way of designing materials and techniques outside of language, speech, and auditory training. Data have recently been collected through several studies that substantiate this situation in relation to science education for deaf students.

Burch and Sunal (1978) surveyed elementary science curricula in forty-seven residential schools for hearing-impaired students and reported that 21% have no established science programs for grades K-6. Fewer than

20% of the schools surveyed used guides for special help, or strategies and activities different from approaches used in regular school curricula. The authors concluded that if this sample is typical of all schools in the population, science curricula in a majority of schools are not providing appropriate science education for young hearing-impaired students.

In a more comprehensive study, Lang and Propp (1981) surveyed 479 science teachers serving deaf students in 326 school programs in 45 states and the District of Columbia. Nearly 74% of the respondents had no degrees in science education. Over 56% of the science teachers had studied fewer than twelve credits in undergraduate science. Almost 90% had fewer than twelve credits in graduate school science. The survey evaluated education and training of science teachers and the general adequacy of curricula, instructional resources and facilities. In all areas that state of science education was found wanting.

Through the years it appears that a vicious cycle has been created in the education of the deaf. On the one hand, those who are able to effect change in the school curriculum take note of the low priority science has received historically. The attitude is taken that if national leaders do not recognize the worth of science, then they must know something. The myth that science is "not for deaf students" continues to be perpetuated through ignorance.

On the other hand, those involved with national curriculum planning efforts in the education of the deaf work with data obtained from school programs. Since science is given such low priority by the schools, it is assumed that there must be insufficient support for a project to

upgrade science teacher training or the quality of curriculum materials.

The status of science education for deaf students is low and in practically all facets of the field, leadership is needed. Granted that there has been more interest and work in the area since PL 94-142, that some good programs do exist, and that there are some highly qualified educators presently teaching science, a formidable challenge still lies ahead in going beyond the status quo.

The Status of Career Education for Deaf Students

In years prior to 1965, career education often was limited to specific vocational training in the state residential schools for the deaf. Once a student graduated from such a program, he or she often had received specific skill training in a field and was then expected to enter the job market.

Updegraff and Egelston-Dodd (1981) point out that although this was certainly of great benefit to countless deaf persons, it was limiting in a number of ways:

- The occupations for which students were trained were often determined by sex, availability of specialized equipment in the schools or by other factors;
- Students were often "tracked" as academic or vocational from a relatively early age and, once tracked thusly, it was difficult to change tracks as a student's interests and talents matured;
- Little attention was paid to labor market trends in students' communities for the purpose of shifting the offerings in a particular school's curriculum;
- Little attention was paid to supplemental programs related to students' career development; for example, learning to use a checkbook, to complete job application forms, to driver education, to consumer math, and to other critical life skills components of successful career development.

Further, the broader society of the times was far less accepting of handicapped workers. Deaf persons did not have the protection against discrimination currently offered by Sections 503 and 504; there were few interpreters outside the major metropolitan areas or away from the schools for the deaf except for hearing family members. There were also innumerable barriers to successful career development (Upagraff & Egelston-Dodd, 1981).

Stolte (1979) has described how the handicapped face many barriers to successful career development. The most notable include the lack of role models, deprivation of content in their schooling, and discrimination based on negative societal expectations and personal aspirations. Deaf students must face all these problems and overcome the additional burden of a communication barrier.

Deafness, like sex, represents a characteristic regarded by society as a handicap for holding certain jobs. Hearing-impaired students suffer not only the same curriculum deprivations that perpetuate stereotyping of occupations as their hearing peers, but also they have not had career education exposures which have been planned and implemented with their particular type of handicap in mind (Munson & Egelston, 1974). Junior high school-aged deaf adolescents are reportedly three times more likely to stereotype occupations by sex than are their hearing peers (Egelston & Kovolchuk, 1976), and the correlation of stereotyping jobs by sex and by deafness for deaf college students was found highly significant (Egelston-Dodd, 1977).

Not only are deaf workers found in disproportionately large numbers among low paying, low status, dead-end jobs, but the majority of deaf students at the two colleges for deaf students (Gallaudet College and National Technical Institute for the Deaf) are enrolled in programs traditionally appropriate for their sexual identity (Cook & Rossett, 1975). Both distributions show the effect of self-selection and aspiration based on traditional stereotyped notions of what deaf men or deaf women can do. Deaf adolescent women reportedly have a more traditional view of their sex role as manifested in vocational choices than do their hearing peers.

Numerous studies have shown that educators of the deaf recognize the inadequacy of career education in school programs serving hearing impaired students. Curtis (1976) surveyed educators to prioritize the needs for instructional materials. Career education ranked as a high priority need. Respondents felt a strong need for instructional materials to assist them with developing in their students a positive view of self and others, positive attitudes toward preparation required for occupation, knowledge of duties and responsibilities involved in various occupations, and knowledge of specific sources of information about careers. In another study, Prickett & Hunt (1977) identified high priority areas in need of attention in the education of the deaf over the next ten years. Out of 48 "high desirability" items, "more attention to career education and career needs of the deaf" ranked eighth. In a more recent study, Maruggi (1980) found a strong, positive reaction toward career education goals among administrators and vocational and academic faculty in residential and day programs. Maruggi concludes that while career education has the

potential for improving the formal preparation of young deaf people in our society, the support of educators is necessary in order to successfully implement programs and meet the career development needs of this population. He stresses the importance of well-planned career education programs in the schools.

There is a general dearth of literature regarding the education of the deaf which illustrates programmatic efforts focusing on career education. Wentling, Butterweck, and Zook (1976) describe a career awareness program which included orientation and counseling components. Polansky (1979) describes a summer employment program for deaf youth in which teachers have opportunities for observing changes in attitudes of both students and employers. The eight-week project provides information so that the teachers can improve their preparation of deaf students for occupations in a competitive job market. Maxwell, Cleary, Lubbers, and Ireland (1977) discuss a program for low-achieving deaf high school students which teaches them various aspects of employment, including the self-awareness concepts of attitudes, grooming, and the assumption of responsibilities, as well as economic awareness concepts such as the relationship between increased pay and improved skill.

In 1971, the Cooperative Research Endeavors in the Education of the Deaf (CREED) project was undertaken to implement the various developmental theories of vocational choice that consider choosing a career as a process extending over a period of many years.

During Phase I, the Career Insights and Self-Awareness Gaming Program materials were tested with deaf students. In Phase II, a new component,

Learning About Work, the field trip, was developed. The arrangements for making a community survey of appropriate industries and for contacting business people to organize a visit by a class of deaf students were included in The Teacher's Manual for Learning About Work Through Field Trips.

During Phase III of the project, three new components were developed and tested: 1) the Work Function Slide Series, consisting of 23 work function slide sets; 2) the Career Opportunities for Deaf Students Series, consisting of 40 career information briefs; and 3) the work values clarification strategies as presented in Clarifying Work Values. Each component helps implement one or more of the four channels of career-learning-maturation: 1) the self, 2) the conceptual, 3) the experiential, and 4) the informational. Learning exposures in these channels are provided by various activities which use the concepts and vocabulary of the occupational categories and system of classification devised by the United States Department of Labor. In 1975, the materials and activities were tested in 20 schools for the deaf across the United States as part of a teacher in-service training project sponsored by the Bureau for the Education of the Handicapped (Munson & Egelston, 1974).

In 1978, the Pre-college Programs at Gallaudet College and the National Technical Institute for the Deaf (NTID) began joint support of the National Project on Career Education (NPCE). The NPCE was specifically designed to generate and provide solutions to the career education needs of deaf students identified in two working conferences held earlier in 1978. Its purpose was to focus on in-service training in career

education for educators working with primary, elementary, and secondary level hearing impaired students. The long-range goal for the NPCE is:

> Each state will have a model career education program and a cadre of career education facilitators who can assist the personnel in other schools serving hearing impaired students to a) develop and implement plans for a comprehensive K-12 career education program, and b) infuse career education concepts into the school curriculum (Egelston-Dodd, 1981).

Operationally the NPCE spans three stages. The first stage, 1978-79, resulted in the development and implementation of a model workshop on career education and planning skills and a program of technical assistance. The workshop and technical assistance program were prototype-tested with eight participant schools from five states in the northwest region and the State of California. An additional workshop component on how to deliver intensive training in workshop format was developed to train participants to become better facilitators.

In the second stage, 1979-80, the delivery skills, career education and planning skills contents were taught by a national training team composed of facilitators drawn from the staffs of the NTID and the Model Secondary School for the Deaf (MSSD) at Gallaudet at four regional sites.

During stage three, 1980-81, four more regional workshops with a focus on summative evaluation of the model workshop, (to make the program eligible for replication funding for dissemination within each state) were conducted. Presently, 60 member schools in 42 states are implementing career education in-service training as a result of NPCE (Egelston-Dodd, 1981).

These career education programs are the major curriculum efforts now underway to enhance the career development of deaf students. The present study will identify the science career development needs of deaf students and provide data which will have implications for these and future career education programs for deaf students.

PROCEDURES

This descriptive study included the following procedures: a review of the literature; a preliminary identification of needs; the development and administration of a questionnaire; and the analysis of the resulting data, derivation of implications, and formulation of recommendations. Each of these procedures is described below.

Review of the Literature

The review of the literature covered the status of science education for deaf students and the status of career education and career development for deaf students.

Preliminary Identification of Needs

The preliminary identification of the science career development needs of deaf students was accomplished by drawing on the knowledge of a panel of eight national experts. This panel included science practitioners, science employers, science educators, career development specialists, deaf education specialists, and representatives of the deaf community. Each of these experts had experience in or were familiar with deafness.

The panel members were provided with a description of the study, a list of five example need statements, and a description of the specific procedures they were to follow. The members of the panel were asked to identify additional science career development needs of deaf students. All of the panel's responses, obtained over the tele-

phone and through the mail, were summarized and analyzed. Based on this analysis, a list of 24 needs statements was determined. These needs statements were grouped by topical areas and this list of needs statements formed the basis of the questionnaire used in the validation of the preliminary needs.

Development and Administration of Questionnaire

The questionnaire listed the 24 science career development needs as identified by the panel (see Appendix A for a copy of the questionnaire). Provision for responses was made using a five-point scale with values ranging from "Much more important than other needs on this list," to "Much less important than other needs on this list," and finally to "Not a need." Each respondent checked the self-perceived degree of importance of each proposed need. A final section of the questionnaire permitted respondents to identify additional needs.

The questionnaire was submitted to experts in questionnaire construction for criticisim and possible revision. Once revised, the questionnaire was pilot tested by asking approximately twenty colleagues, unfamiliar with the study, if they understood the questionnaire and could respond if they were familiar with the topic. Those individuals participating in the pilot test were not part of the study.

The respondents to the survey represented eight groups: deaf scientists, science industry, science educators of deaf students, career development specialists working with deaf students, rehabilitation programs and services for deaf persons, community programs and supportive services

for deaf persons, and educational programs training those who work with deaf students. A primary source in the identification of these individuals was the panel and also the "Directory of Programs and Services," American Annals of the Deaf, CXXII (April, 1981).

Twenty individuals representing each group were sought to participate in the study. The panel was asked, "If you were to identify twenty people who represent [e.g.,] 'rehabilitation programs and services for deaf persons,' who would you select?" For some groups it was difficult to identify twenty persons, for other groups more than twenty names were suggested initially.

The questionnaire was mailed on September 22nd with a letter describing the study and the importance of having 100% response (see Appendix B for a copy of the letter). Some responses were received almost immediately and within the first two weeks a few individuals called or wrote saying that they would not be able to participate. In cases where the individual was ill or on foreign travel, a replacement was sought by asking for additional names from panel members most familiar with the area in question. In other cases a phone call was made to further explain the selection process and the need for that individual's response. This procedure worked in all but a few cases where the individuals were still not convinced they were qualified to respond or had the time to respond. In all, twenty additional respondents were identified following the original 160.

On October 12th, phone calling began to those individuals who had not mailed back their completed questionnaire. Approximately three quarters of the participants were called. Of those called, approximately one-half

requested that a second copy of the questionnaire be mailed to them. Two weeks after a first follow-up call, a second was made if there had been no response. Very accurate records were kept regarding the telephone calls made and second questionnaires sent. By November 10th, completed questionnaires had been received from all 160 participants.

Analysis of Data

Data resulting from the questionnaire were coded and keypunched for computer processing. Analysis was accomplished using subprograms of the Statistical Package for the Social Science (SPSS).

For each questionnaire item, the following were computed: the frequency of response for each of the five points on the scale, the percent of response, the mean response, and the associated standard deviation and standard error of the mean. These statistics were computed for each item, for each of the eight groups of respondents, and for the total group of respondents.

Additionally, for each item a one-way analysis of variance was computed to determine if there were significant differences among the mean ratings of the eight groups. For each resulting significant F-value ($p<.05$) appropriate *post hoc* tests were performed to identify the groups with significantly different mean ratings.

As the surveys were received, all additional needs identified by the respondents were compiled. In some cases, respondents wrote letters to accompany their survey to explain the additional need they had identified.

When all the surveys had been received, these additional needs were grouped and a needs statement that encompassed the concepts being suggested were written.

Tables were prepared to describe the data. These are presented in the results section that follows.

RESULTS

The results of the survey to identify the science career development needs of deaf students are reported in the following manner: Statistical Description of Survey Needs Statements and Identification of Additional Needs Statements.

Statistical Description of Survey Needs Statements

Tables 1 through 24 present basic statistical information regarding the responses of the eight respondent groups to the 24 needs presented in the Survey of Science Career Development Needs of Deaf Students. The first column on each of these tables lists the eight respondent groups polled. The second column indicates the number of respondents in each group to rate that need statement. The subsequent five columns indicate the percentage of each respondent group designating each response category: thus, 36.8 under the column "much more" means that 36.8% of the respondents in Group A, Deaf Scientists, designated that particular need as being much more important than the other needs on the survey form. The final column, headed $\bar{X}$, presents the mean scores for each need for each respondent group. These scores were calculated by ascribing a value from 4 (meaning "Much More") to 0 (meaning "Not A Need") to the survey responses.

In order to determine whether or not the needs were rated differently by each respondent group, analyses of variance were performed on the means for each need between respondent groups. Of the 24 analyses run, only two yielded statistically significant differences ($p<.05$). Since the two

statistically significant differences were within the spurious range in running this large number of analyses, the findings indicate no consistent significant differences between groups in the rating of the various needs. Refer to Tables 1 through 24 (Appendix C) for a detailed statistical description of the need ratings by respondent groups.

Table 25 (page 31) summarizes the statistical information on the ratings for all 24 needs across all respondent groups. This table presents in columns the mean ratings for each respondent group for all 24 of the need statements. The final column on Table 25 indicates the overall mean ratings summed across respondent groups for each of the 24 need areas. The relative importance of each need can be seen from this overall rating. This last column shows the needs displayed a substantial range of ratings, from a low of 2.02 to a high of 3.61.

Table 26 (page 32) then presents further descriptive information by arranging the 24 need statements in order of their overall total scores summed across respondent groups. The needs are presented in order of their importance to all respondent groups combined.

It is important to note that the eight need statements which were ranked the highest, would all provide very concrete career information to the deaf student. The first two need statements would provide the deaf student with self-assessment information (seeing a role model, a deaf student can consider "I am like that person; therefore,..." as would actually having an opportunity to assess their interests, assets,

TABLE 25
Mean Need Scores by Respondent Group

Need \ Respondent Group	A	B	C	D	E	F	G	H	T
a. Encouragement to learn more about science	3.26	3.2	3.2	3.35	3.2	3.1	3.25	3.1	3.2
b. More science lessons in elementary schools for deaf students	3.15	3.1	3.25	3.15	2.95	3.0	3.16	3.15	3.11
c. Science courses in grades 7-12 developed specifically for deaf students	3.05	3.3	2.85	3.3	3.15	3.25	3.16	2.78	3.1
d. Literacy of science topics in a variety of periodicals	2.65	2.05	2.4	2.0	2.45	2.15	2.55	1.75	2.25
e. An awareness of the importance/impact of science and technology in/on our lives today	3.35	2.95	2.95	3.25	3.35	2.75	3.15	3.2	3.11
f. An awareness of the market for scientific and technical skills today	3.3	3.36	3.15	3.6	3.25	3.1	3.3	2.65	3.21
g. An awareness of the variety of science careers available	3.5	3.5	3.3	3.65	3.36	3.2	3.25	3.35	3.39
h. An awareness of the various work functions that individuals perform in science careers	3.4	3.55	3.2	3.35	3.35	3.25	3.05	2.6	3.21
i. Information regarding technical and semi-professional science occupations	2.94	3.42	2.7	3.2	3.35	3.2	3.0	2.84	3.08
j. Understanding of the emerging roles of women in science	2.35	2.7	2.4	2.7	2.2	2.31	2.4	1.94	2.38
k. A realization that science offers professional career opportunities for handicapped people	3.4	3.6	3.55	3.4	3.25	3.35	3.3	3.3	3.39
l. A realization that science offers professional career opportunities for women	2.35	2.9	2.55	2.85	2.55	2.5	2.55	2.10	2.54
m. A realization that science offers professional career opportunities for minorities	2.5	2.95	2.6	2.7	2.35	2.5	2.45	2.10	2.52
n. Role models of deaf individuals currently employed in science-related occupations	2.65	3.45	3.65	3.55	3.75	3.8	3.55	3.55	3.61
o. Identification with role models of deaf individuals in "responsible" science careers	3.2	3.52	3.35	3.4	3.6	3.55	3.3	3.15	3.38
p. Realization that there is nothing new about a deaf person in a science career through study of 19th century deaf scientists	2.05	2.10	2.26	2.05	2.3	2.45	2.0	1.52	2.09
q. Information regarding the ways some deaf people in science careers adapt work and personal lives to compensate for deafness	3.4	3.31	3.4	3.0	3.0	3.5	3.2	2.68	3.19
r. Identification of potential barriers to science careers and methods of resolving them	3.2	3.31	3.15	3.3	3.15	2.8	3.0	2.88	3.1
s. Visits to scientists' work sites/science industry facilities	3.0	3.21	3.15	3.05	3.25	3.25	3.1	2.89	3.11
t. Exposure to people engaged in science	3.05	3.0	3.05	2.95	3.1	2.95	2.9	3.0	3.0
u. Familiarity with communication among workers in science careers	3.15	2.73	2.55	2.4	2.9	2.65	2.5	2.66	2.69
v. An appreciation of the rich and varied lives that scientists lead	2.45	2.05	2.0	1.7	1.95	2.05	2.05	1.94	2.02
w. An opportunity to assess their own interests, assets, abilities, and needs related to the demands of a career in science	3.5	3.57	3.3	3.7	3.45	3.3	3.65	3.42	3.48
x. An awareness of the educational opportunities in science preparation beyond high school	3.5	3.63	3.1	3.3	3.5	3.1	3.25	3.10	3.31

TABLE 26
Ranked Needs Statements

(1) n. Role models of deaf individuals currently employed in science-related occupations

(2) w. An opportunity to assess their own interests, assets, abilities, and needs related to the demands of a career in science

(3) g. An awareness of the variety of science careers available

(4) k. A realization that science offers professional career opportunities for handicapped people

(5) o. Identification with role models of deaf individuals in "responsible" science careers

(6) x. An awareness of the educational opportunities in science preparation beyond high school

(7) f. An awareness of the market for scientific and technical skills today

(8) h. An awareness of the various work functions that individuals perform in science careers

(9) a. Encouragement to learn more about science

(10) q. Information regarding the ways some deaf individuals in science careers adapt their work and personal lives to compensate for their deafness

(11) b. More science lessons in elementary schools for deaf students

(12) e. An awareness of the importance/impact of science and technology in/on our lives today

(13) s. Visits to scientists' work sites/science industry facilities

(14) c. Science courses in grades 7 to 12 developed specifically for deaf students

(15) r. Identification of potential barriers to science careers and methods of resolving them

(16) i. Information regarding technical and semiprofessional science occupations

(17) t. Exposure to people engaged in science

(18) u. Familiarity with communication among workers in science careers

(19) l. A realization that science offers professional career opportunities for women

(20) m. A realization that science offers professional career opportunities for minorities

(21) j. Understanding of the emerging roles of women in science

(22) d. Literacy of science topics in a variety of periodicals

(23) p. Realization that there is nothing new about a deaf person in a science career through study of 19th century deaf scientists

(24) v. An appreciation of the rich and varied lives that scientists lead

abilities, and needs). The next need statements would provide career information regarding: the variety of science careers available, opportunities for handicapped people, role models in "responsible" careers, educational opportunities, the market for scientific skills, and work functions.

The lowest ranked needs statements were much more general; however, based on notes and comments written by the Survey respondents, it appears that the three need statements that ranked the lowest may not have been clearly understood. "An appreciation of the rich and varied lives that scientists lead" ranked the lowest. Some respondents questioned whether or not scientists do lead rich and varied lives while others asked "rich and varied as compared to whom?" "Realization that there is nothing new about a deaf person in a science career through study of 19th century deaf scientists" ranked 23rd. Most comments indicated that this would be best accomplished through a study of 19th and 20th century deaf scientists. "Literacy of science topics in a variety of periodicals" ranked 22nd. Several respondents asked for a definition of the term "literacy".

Identification of Additional Needs Statements

Finally, Table 27 (pages 34-36) presents those additional needs that were identified by the Survey respondents. A content analysis of the open-ended responses suggested four additional need statements, each of which represents a categorization of the open-ended responses.

A need for "training programs for teachers of deaf students" was mentioned (in some form) by several respondents. The respondents mentioning

TABLE 27
Additional Needs Identified

A. Training programs (science education/career development) for teachers of deaf students

RESPONSES	RESPONSE GROUP
• "Teacher training programs that include science training in deaf education"	G. Community Programs
• "Training programs for teachers need to be improved - such as methods course in science teaching for deaf education majors"	C. Science Educators
• "In-service for teachers of the deaf"	C. Science Educators
• "Need to make teachers of deaf aware of value of using materials especially designed for them (NSF, BEH, etc. projects)"	G. Community Programs
• "Up-grading the skills of teachers of elementary science to enable teaching concepts instead of facts"	H. Training Programs
• "More qualified science instructors at junior and senior high level"	H. Training Programs
• "More, better qualified science teachers in upper elementary grades and up"	E. Rehabilitation Programs
• "Specific training requirements for elementary deaf education teachers in the sciences"	G. Community Programs

B. A foundation in the basic skills: reading, writing, computation

RESPONSES	RESPONSE GROUP
• "Reading and writing skills"	A. Deaf Scientists
• "Better academic preparation in elementary and secondary schools in math, english, reading"	B. Science Industry
• "An awareness of the necessity of a sound English and mathematical background to be successful in a science career"	H. Training Programs
• "Allied coursework: math and logic for deaf junior and high school students"	A. Deaf Scientists
• "Awareness of the importance of intelligible written communications, i.e., good English"	A. Deaf Scientists

TABLE 27 Continued

• "Awareness of the generality of math application in science: math for communication"	A. Deaf Scientists
• "Familiarization with requirement to communicate adequately in a science career by technical writing"	B. Science Industry

C. Information regarding the world of work

RESPONSES	RESPONSE GROUP
• "Realistic information about working and what employers expect from their employees"	A. Deaf Scientists
• "Indoctrination about the realities of living/working"	A. Deaf Scientists
• "Thorough understanding of the employment rights of handicapped persons"	B. Science Industry
• "Students need to know the importance of the work/study effort involved in becoming a worker in the sciences"	G. Community Programs
• "Information on specific work functions, task analysis, and expectations/requirements for science careers"	H. Training Programs
• "Identification of the cognitive processing skills needed for various science careers"	H. Training Programs

D. Sufficient support services, resources, and materials

RESPONSES	RESPONSE GROUP
• "Need support services in classrooms (interpreters, etc.)"	G. Community Programs
• "Adequate resources and materials"	G. Community Programs
• "Interpreters (quality and knowledge of scientific sign)"	B. Science Industry
• "Need for 'critical mass' at any one school in order to provide sufficient equipment, resources, science experiences"	G. Community Programs

TABLE 27 Continued

E. Other needs

RESPONSES	RESPONSE GROUP
• "Educate instructors and counselors about science/technical careers"	B. Science Industry
• "A plan to convince the schools for the deaf of the need for a program addressing these needs"	A. Deaf Scientists
• "A comprehensive curriculum guide for sequential progression/development in science education"	E. Rehabilitation Programs
• "Basic research in the methods and materials to be used in the education of the deaf in science areas"	G. Community Programs
• "Awareness/realization of the opportunities and potentials for success of deaf people in science on the part of parents, early in deaf students' education"	F. Educational Programs
• "National science career information network/clearinghouse"	C. Science Educators
• "Visits to science fairs (state fairs with scientific displays, etc.), planetariums, etc."	E. Rehabilitation Programs

this need belonged to the "training programs," "community program," and "science educators" categories.

Respondents who are themselves deaf scientists or belong to the science industry response group, identified a need for "a foundation in the basic skills: reading, writing, computation" and a need for "information regarding the world of work."

A need for "sufficient support services, resources, and materials" was suggested mainly by individuals from the "community programs" response group.

Other needs, identified by one survey respondent, are listed at the end of Table 27. They follow no particular pattern and cannot necessarily be considered as a "special interest" of the respondent's group.

IMPLICATIONS

The present study has several major implications for the science career preparation of deaf students. These implications are of three kinds: those which support and extend assertions already in the literature, those which run counter the literature, and those which represent new areas for exploration. This section reviews the specific study implications.

Related to the first kind of implication, the results of this study add support to earlier statements in the literature which had not previously been backed by data. For example, the first two factors related to deafness which tend to create career development problems for deaf individuals sited by Hoeman (1965) as receiving considerable attention from psychologists: (1) the lack of information about the world of work and (2) the lack of insight regarding their interests and abilities, are supported by the ranked needs statements. When the needs statements from the survey were ranked (see Table 26, page 32), needs related to information about the world of work ranked as seven of the first eight needs statements. The second ranked needs statement was "An opportunity to assess their own interests, assests, abilities, and needs...," Hoeman's second factor. Also, "information regarding the world of work" was specifically identified as an additional need by several respondents.

Also, Lang and Propp (1981) have shown that the curriculum materials developed for children with normal hearing (under the auspices of the National Science Foundation) are not used extensively in the education of deaf students.

They suggest that this may be because of inadequate training and information dissemination techniques in the education of deaf students. This is obviously a concern of the survey respondents since several identified "training programs for teachers of deaf students" as a need not addressed by the survey.

An implication regarding women in science careers runs counter to the literature. Although Updegraff and Egelston-Dodd (1981), Egelston and Kovolchuk (1976), Egelston-Dodd (1977), and Cook and Rossett (1975) all identified sexual sterotyping in career development as a major problem for deaf students, the survey respondents rated those needs statements relating to "opportunities for women" and the "emerging role of women in science" as less important than the other needs. It may be that the other needs are seen by the respondents as more basic and therefore more important by comparison or if one had unlimited funds.

A similar implication is based on a need mentioned in the literature but not identified by the panel or suggested as a need by the respondents. Lang (1981) points out that the infusion of career education concepts with science education may be an effective practice. Infusion adds relevance to the content by relating what the child is learning to the world of work. Perhaps the potential for science to provide a context for career development is a sophisticated need that would not necessarily be considered by someone filling out a brief survey or perhaps the term "infusion" is one used by only a select group.

Finally, the resulting ranking of needs *per se* must be considered as an empirical statement of need priorities. Since the need statement regarding role models stands out as the most highly endorsed need, the implications of this ranking must be considered. The survey respondents do believe that role models of deaf individuals currently employed in science-related occupations are needed by deaf students. What is known about the best practices for using role models? Documentation of the experiences of using role models in science career preparation is needed.

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APPENDIX A

Survey of Science Career Development Needs
of Deaf Students

SURVEY OF SCIENCE CAREER DEVELOPMENT NEEDS OF DEAF STUDENTS

DIRECTIONS: Place an X in the box which describes your opinion of the degree of importance of each need. If you do not consider an item a need, place an X in the appropriate box. Please don't leave any item blank. If you identify additional needs, please write them in at the bottom of the questionnaire and rate them using the same scale.	Much More Important Than Other Needs on This List	Somewhat More Important Than Other Needs on This List	Somewhat Less Important Than Other Needs on This List	Much Less Important Than Other Needs on This List	Not a Need
a. Encouragement to learn more about science	4	3	2	1	☐
b. More science lessons in elementary schools for deaf students	4	3	2	1	☐
c. Science courses in grades 7 to 12 developed specifically for deaf students	4	3	2	1	☐
d. Literacy of science topics in a variety of periodicals	4	3	2	1	☐
e. An awareness of the importance/impact of science and technology in/on our lives today	4	3	2	1	☐
f. An awarene s of the market for scientific and technical skills today	4	3	2	1	☐
g. An awareness of the variety of science careers available	4	3	2	1	☐
h. An awareness of the various work functions that individuals perform in science careers	4	3	2	1	☐
i. Information regarding technical and semiprofessional science occupations	4	3	2	1	☐
j. Understanding of the emerging roles of women in science	4	3	2	1	☐
k. A realization that science offers professional career opportunities for handicapped people	4	3	2	1	☐
l. A realization that science offers professional career opportunities for women	4	3	2	1	☐
m. A realization that science offers professional career opportunities for minorities	4	3	2	1	☐
n. Role models of deaf individuals currently employed in science-related occupations	4	3	2	1	☐

A-3

	Much More Important Than Other Needs on This List	Somewhat More Important Than Other Needs on This List	Somewhat Less Important Than Other Needs on This List	Much Less Important Than Other Needs on This List	Not a Need
o. Identification with role models of deaf individuals in "responsible" science careers	4	3	2	1	☐
p. Realization that there is nothing new about a deaf person in a science career through study of 19th century deaf scientists	4	3	2	1	☐
q. Information regarding the ways some deaf individuals in science careers adapt their work and personal lives to compensate for their deafness	4	3	2	1	☐
r. Identification of potential barriers to science careers and methods of resolving them	4	3	2	1	☐
s. Visits to scientists' work sites/science industry facilities	4	3	2	1	☐
t. Exposure to people engaged in science	4	3	2	1	☐
u. Familiarity with communication among workers in science careers	4	3	2	1	☐
v. An appreciation of the rich and varied lives that scientists lead	4	3	2	1	☐
w. An opportunity to assess their own interests, assets, abilities, and needs related to the demands of a career in science	4	3	2	1	☐
x. An awareness of the educational opportunities in science preparation beyond high school	4	3	2	1	☐
y.	4	3	2	1	☐
z.	4	3	2	1	☐

APPENDIX B

Letter Accompanying Survey

Research for Better Schools, Inc.
444 North Third Street, Philadelphia, Pennsylvania 19123 • (215) 574-9300

September 22, 1981

Dear Colleague,

As part of a National Science Foundation grant, I am attempting to identify the science career development needs of deaf students. Your help is urgently sought in this study.

The enclosed questionnaire lists the science career development needs of deaf students as identified by a panel of experts. In order to validate this preliminary list of needs, the questionnaire is being administered to 160 individuals representing: deaf scientists, science industry, science educators working with deaf students, career development specialists working with deaf students, rehabilitation programs and services for deaf persons, community programs and supportive services for deaf persons, educational programs and services for deaf persons, and educational programs training those who work with deaf students. Your response is one of twenty questionnaires which must be completed for each category for successful completion of this study.

You will be asked to compare the relative importance of the 24 items on the list. Your response should be recorded on the four-point scale. *Please place an X in the box which describes your opinion of the degree of importance of each need. If you do not consider an item a need, place an X in the appropriate box. Please don't leave any item blank. If you identify additional needs, please write them in at the bottom of the questionnaire and rate them using the same scale.*

Please complete the questionnaire promptly and return it to me in the enclosed self-addressed, stamped envelope. The results of the study will be mailed to you in late November.

Your help is appreciated. Thank you for your time.

Sincerely,

Joanne B. Stolte

Joanne B. Stolte, Director
Special Projects Division

JBS/jg
Enclosures

APPENDIX C

Tables 1 through 24:
Statistical Description of Responses to
Needs Statements a through x
by Respondent Groups

TABLE 1
Statistical Description of Responses to
Need a. "Encouragement to Learn More About Science"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	19	36.8	52.6	10.5	0.0	0.0	3.26
B. Science industry	20	35.0	50.0	15.0	0.0	0.0	3.2
C. Science educators	20	40.0	40.0	20.0	0.0	0.0	3.2
D. Career specialists	20	40.0	55.0	5.0	0.0	0.0	3.35
E. Rehabilitation programs	20	30.0	60.0	10.0	0.0	0.0	3.2
F. Community programs	20	25.0	65.0	5.0	5.0	0.0	3.1
G. Educational programs	20	40.0	45.0	15.0	0.0	0.0	3.25
H. Training programs	20	35.0	45.0	15.0	0.0	0.0	3.1
TOTAL	159	35.2	51.6	11.9	1.3	0.0	3.2

TABLE 2
Statistical Description of Responses to
Need b. "More Science Lessons in Elementary Schools for Deaf Students"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	45.0	30.0	20.0	5.0	0.0	3.15
B. Science industry	20	30.0	50.0	20.0	0.0	0.0	3.1
C. Science educators	20	45.0	35.0	20.0	0.0	0.0	3.25
D. Career specialists	20	25.0	65.0	10.0	0.0	0.0	3.15
E. Rehabilitation programs	20	20.0	60.0	15.0	5.0	0.0	2 95
F. Community programs	20	20.0	65.0	10.0	5.0	0.0	3.0
G. Educational programs	18	50.0	22.2	22.2	5.6	0.0	3.16
H. Training programs	20	40.0	40.0	15.0	5.0	0.0	3.15
TOTAL	158	34.2	46.2	16.5	3.2	0.0	3.11

TABLE 3
Statistical Description of Responses to
Need c. "Science Courses in Grades 7-12 Developed Specifically for Deaf Students"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	30.0	45.0	25.0	0.0	0.0	3.05
B. Science industry	20	55.0	25.0	15.0	5.0	0.0	3.3
C. Science educators	20	55.0	5.0	25.0	0.0	15.0	2.85
D. Career specialists	20	45.0	40.0	15.0	0.0	0.0	3.3
E. Rehabilitation programs	20	35.0	45.0	20.0	0.0	0.0	3.15
F. Community programs	20	40.0	50.0	5.0	5.0	0.0	3.25
G. Educational programs	18	50.0	22.2	22.2	5.6	0.0	3.16
H. Training programs	19	42.1	26.3	15.8	0.0	15.8	2.78
TOTAL	157	43.9	32.5	17.8	1.9	3.8	3.1

TABLE 4
Statistical Description of Responses to
Need d. "Literacy of Science Topics in a Variety of Periodicals"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	30.0	20.0	35.0	15.0	0.0	2.65
B. Science industry	20	5.0	30.0	35.0	25.0	5.0	2.05
C. Science educators	20	25.0	20.0	35.0	10.0	10.0	2.4
D. Career specialists	20	0.0	20.0	60.0	20.0	0.0	2.0
E. Rehabilitation programs	20	15.0	25.0	50.0	10.0	0.0	2.45
F. Community programs	20	10.0	20.0	45.0	25.0	0.0	2.15
G. Educational programs	20	10.0	45.0	35.0	10.0	0.0	2.55
H. Training programs	20	0.0	15.0	55.0	20.0	10.0	1.75
TOTAL	160	11.9	24.4	43.8	16.9	3.1	2.25

TABLE 5
Statistical Description of Responses to Need e. "An Awareness of the Importance/Impact of Science and Technology in/on our Lives Today"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	50.0	35.0	15.0	0.0	0.0	3.35
B. Science industry	20	35.0	30.0	30.0	5.0	0.0	2.95
C. Science educators	20	25.0	45.0	30.0	0.0	0.0	2.95
D. Career specialists	20	50.0	25.0	25.0	0.0	0.0	3.25
E. Rehabilitation programs	20	50.0	35.0	15.0	0.0	0.0	3.35
F. Community programs	20	5.0	70.0	20.0	5.0	0.0	2.75
G. Educational programs	20	35.0	45.0	20.0	0.0	0.0	3.15
H. Training programs	20	25.0	70.0	5.0	0.0	0.0	3.2
TOTAL	160	34.4	44.4	20.0	1.2	0.0	3.11

TABLE 6
Statistical Description of Responses to
Need f. "An Awareness of the Market for Scientific and Technical Skills Today"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	45.0	40.0	15.0	0.0	0.0	3.3
B. Science industry	19	52.6	36.8	5.3	5.3	0.0	3.36
C. Science educators	20	30.0	60.0	5.0	5.0	0.0	3.15
D. Career specialists	20	60.0	40.0	0.0	0.0	0.0	3.6
E. Rehabilitation programs	20	45.0	40.0	10.0	5.0	0.0	3.25
F. Community programs	20	25.0	60.0	15.0	0.0	0.0	3.1
G. Educational programs	20	35.0	60.0	5.0	0.0	0.0	3.3
H. Training programs	20	25.0	35.0	20.0	20.0	0.0	2.65
TOTAL	159	39.6	46.5	9.4	4.4	0.0	3.21

TABLE 7
Statistical Description of Responses to
Need g. "An Awareness of the Variety of Science Careers Available"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	60.0	30.0	10.0	0.0	0.0	3.5
B. Science industry	20	55.0	40.0	5.0	0.0	0.0	3.5
C. Science educators	20	35.0	60.0	5.0	0.0	0.0	3.3
D. Career specialists	20	70.0	25.0	5.0	0.0	0.0	3.65
E. Rehabilitation programs	19	47.4	42.1	10.5	0.0	0.0	3.36
F. Community programs	20	35.0	50.0	15.0	0.0	0.0	3.2
G. Educational programs	20	35.0	55.0	10.0	0.0	0.0	3.25
H. Training programs	20	55.0	25.0	20.0	0.0	0.0	3.35
TOTAL	159	49.1	40.9	10.1	0.0	0.0	3.39

TABLE 8
Statistical Description of Responses to Need h. "An Awareness of the Various Work Functions that Individuals Perform in Science Careers"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	50.0	40.0	10.0	0.0	0.0	3.4
B. Science industry	20	60.0	35.0	5.0	0.0	0.0	3.55
C. Science educators	20	30.0	60.0	10.0	0.0	0.0	3.2
D. Career specialists	20	45.0	45.0	10.0	0.0	0.0	3.35
E. Rehabilitation programs	20	40.0	55.0	5.0	0.0	0.0	3.35
F. Community programs	20	40.0	45.0	15.0	0.0	0.0	3.25
G. Educational programs	20	25.0	55.0	20.0	0.0	0.0	3.05
H. Training programs	20	15.0	40.0	35.0	10.0	0.0	2.6
TOTAL	160	38.1	46.9	13.7	1.2	0.0	3.21

TABLE 9
Statistical Description of Responses to Need i. "Information Regarding Technical and Semiprofessional Science Occupations"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	19	31.6	36.8	26.3	5.3	0.0	2.94
B. Science industry	19	57.9	26.3	15.8	0.0	0.0	3.42
C. Science educators	20	20.0	40.0	30.0	10.0	0.0	2.7
D. Career specialists	20	45.0	35.0	15.0	5.0	0.0	3 2
E. Rehabilitation programs	20	55.0	30.0	10.0	5.0	0.0	3.35
F. Community programs	20	35.0	50.0	15.0	0.0	0.0	3.2
G. Educational programs	19	21.1	57.9	21.1	0.0	0.0	3.0
H. Training programs	19	15.8	52.6	31.6	0.0	0.0	2.84
TOTAL	156	35.3	41.0	20.5	3.2	0.0	3.08

TABLE 10
Statistical Description of Responses to Need j. "Understanding of the Emerging Roles of Women in Science"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	20.0	15.0	50.0	10.0	5.0	2.35
B. Science industry	20	30.0	20.0	45.0	0.0	5.0	2.7
C. Science educators	20	10.0	40.0	35.0	10.0	5.0	2.4
D. Career specialists	20	20.0	35.0	40.0	5.0	0.0	2.7
E. Rehabilitation programs	20	10.0	25.0	45.0	15.0	5.0	2.2
F. Community programs	19	15.8	26.3	42.1	5.3	10.5	2.31
G. Educational programs	20	15.0	30.0	40.0	10.0	5.0	2.4
H. Training programs	19	10.5	15.8	42.1	21.1	10.5	1.94
TOTAL	158	16.5	25.9	42.4	9.5	5.7	2.38

TABLE 11
Statistical Description of Responses to Need k. "A Realization that Science Offers Professional Career Opportunities for the Handicapped"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	45.0	50.0	5.0	0.0	0.0	3.4
B. Science industry	20	60.0	40.0	0.0	0.0	0.0	3.6
C. Science educators	20	55.0	45.0	0.0	0.0	0.0	3.55
D. Career specialists	20	60.0	25.0	10.0	5.0	0.0	3.4
E. Rehabilitation programs	20	40.0	50.0	5.0	5.0	0.0	3.25
F. Community programs	20	50.0	40.0	5.0	5.0	0.0	3.35
G. Educational programs	20	45.0	40.0	15.0	0.0	0.0	3.3
H. Training programs	20	50.0	35.0	10.0	5.0	0.0	3.3
TOTAL	160	50.6	40.6	6.3	2.5	0.0	3.39

TABLE 12
Statistical Description of Responses to Need l. "A Realization that Science Offers Professional Career Opportunities for Women"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	15.0	30.0	35.0	15.0	5.0	2.35
B. Science industry	20	35.0	30.0	30.0	0.0	5.0	2.9
C. Science educators	20	25.0	30.0	30.0	5.0	10.0	2.55
D. Career specialists	20	25.0	40.0	30.0	5.0	0.0	2.85
E. Rehabilitation programs	20	15.0	45.0	25.0	10.0	5.0	2.55
F. Community programs	20	20.0	30.0	35.0	10.0	5.0	2.5
G. Educational programs	20	15.0	40.0	35.0	5.0	5.0	2.55
H. Training programs	19	15.8	21.1	31.6	21.1	10.5	2.10
TOTAL	159	20.8	33.3	31.4	8.8	5.7	2.54

TABLE 13
Statistical Description of Responses to Need m. "A Realization that Science Offers Professional Career Opportunities for Minorities"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	25.0	20.0	40.0	10.0	5.0	2.5
B. Science industry	20	35.0	40.0	15.0	5.0	5.0	2.95
C. Science educators	20	25.0	35.0	25.0	5.0	10.0	2.6
D. Career specialists	20	15.0	40.0	45.0	0.0	0.0	2.7
E. Rehabilitation programs	20	15.0	40.0	20.0	15.0	10.0	2.35
F. Community programs	20	20.0	25.0	45.0	5.0	5.0	2.5
G. Educational programs	20	10.0	40.0	35.0	15.0	0.0	2.5
H. Training programs	19	15.8	15.8	42.1	15.8	10.5	2.10
TOTAL	159	20.1	32.1	33.3	8.8	5.7	2.52

TABLE 14
Statistical Description of Responses to Need n. "Role Models of Deaf Individuals Currently Employed in Science-Related Occupations"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	65.0	35.0	0.0	0.0	0.0	3.65
B. Science industry	20	55.0	35.0	10.0	0.0	0.0	3.45
C. Science educators	20	75.0	15.0	10.0	0.0	0.0	3.65
D. Career specialists	20	55.0	45.0	0.0	0.0	0.0	3.55
E. Rehabilitation programs	20	75.0	25.0	0.0	0.0	0.0	3.75
F. Community programs	20	80.0	20.0	0.0	0.0	0.0	3.8
G. Educational programs	20	65.0	30.0	0.0	5.0	0.0	3.55
H. Training programs	20	60.0	35.0	5.0	0.0	0.0	3.55
TOTAL	160	66.2	30.0	3.1	0.6	0.0	3.61

TABLE 15

Statistical Description of Responses to Need o. "Identification with Role Models of Deaf Individuals in 'Responsible' Science Careers"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	40.0	45.0	10.0	5.0	0.0	3.2
B. Science industry	19	68.4	15.8	15.8	0.0	0.0	3.52
C. Science educators	20	45.0	45.0	10.0	0.0	0.0	3.35
D. Career specialists	20	45.0	50.0	5.0	0.0	0.0	3.4
E. Rehabilitation programs	20	70.0	20.0	10.0	0.0	0.0	3.6
F. Community programs	20	60.0	35.0	5.0	0.0	0.0	3.55
G. Educational programs	20	45.0	45.0	5.0	5.0	0.0	3.3
H. Training programs	19	47.4	26.3	21.1	5.3	0.0	3.15
TOTAL	158	52.5	35.4	10.1	1.9	0.0	3.38

TABLE 16

Statistical Description of Responses to Need p. "Realization That There's Nothing New About A Deaf Person in a Science Career through Study of 19th Century Deaf Scientists"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	5.0	30.0	35.0	25.0	5.0	2.05
B. Science industry	19	0.0	31.6	52.6	10.5	5.3	2.10
C. Science educators	19	10.5	31.6	36.8	15.8	5.3	2.26
D. Career specialists	20	20.0	15.0	30.0	20.0	15.0	2.05
E. Rehabilitation programs	20	20.0	15.0	50.0	5.0	10.0	2.3
F. Community programs	20	15.0	30.0	40.0	15.0	0.0	2.45
G. Educational programs	20	5.0	30.0	35.0	20.0	10.0	2.0
H. Training programs	19	5.3	10.5	36.8	26.3	21.1	1.52
TOTAL	157	10.2	24.2	39.5	17.2	8.9	2.09

TABLE 17
Statistical Description of Responses to Need q. "Information Regarding the Ways Some Deaf Individuals in Science Careers Adapt Their Work and Personal Lives to Compensate for Their Deafness"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	50.0	40.0	10.0	0.0	0.0	3.4
B. Science industry	19	47.4	36.8	15.8	0.0	0.0	3.31
C. Science educators	20	55.0	30.0	15.0	0.0	0.0	3.4
D. Career specialists	20	35.0	35.0	25.0	5.0	0.0	3.0
E. Rehabilitation programs	20	40.0	35.0	10.0	15.0	0.0	3.0
F. Community programs	20	65.0	20.0	15.0	0.0	0.0	3.5
G. Educational programs	20	45.0	35.0	15.0	5.0	0.0	3.2
H. Training programs	19	26.3	31.6	31.6	5.3	5.3	2.68
TOTAL	158	45.6	32.9	17.1	3.8	0.6	3.19

TABLE 18
Statistical Description of Responses to Need r. "Identification of Potential Barriers to Science Careers and Methods of Resolution"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	40.0	40.0	20.0	0.0	0.0	3.2
B. Science industry	19	47.4	36.8	15.8	0.0	0.0	3.31
C. Science educators	20	30.0	55.0	15.0	0.0	0.0	3.15
D. Career specialists	20	50.0	35.0	10.0	5.0	0.0	3.3
E. Rehabilitation programs	19	42.1	31.6	26.3	0.0	0.0	3.15
F. Community programs	20	25.0	45.0	15.0	15.0	0.0	2.8
G. Educational programs	20	30.0	40.0	30.0	0.0	0.0	3.0
H. Training programs	18	27.8	44.4	22.2	0.0	5.6	2.88
TOTAL	156	36.5	41.0	19.2	2.6	0.6	3.1

TABLE 19
Statistical Description of Responses to
Need s. "Visits to Scientists' Work Sites/Science Industry Facilities"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	30.0	45.0	20.0	5.0	0.0	3.0
B. Science industry	19	47.4	26.3	26.3	0.0	0.0	3.21
C. Science educators	20	40.0	40.0	15.0	5.0	0.0	3.15
D. Career specialists	20	20.0	65.0	15.0	0.0	0.0	3.05
E. Rehabilitation programs	20	35.0	55.0	10.0	0.0	0.0	3.25
F. Community programs	20	40.0	45.0	15.0	0.0	0.0	3.25
G. Educational programs	20	30.0	50.0	20.0	0.0	0.0	3.1
H. Training programs	19	21.1	63.2	0.0	15.8	0.0	2.89
TOTAL	158	32.9	18.7	15.2	3.2	0.0	3.11

TABLE 20
Statistical Description of Responses to
Need t. "Exposure to People Engaged in Science"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	25.0	55.0	20.0	0.0	0.0	3.05
B. Science industry	19	26.3	47.4	26.3	0.0	0.0	3.0
C. Science educators	20	25.0	55.0	20.0	0.0	0.0	3.05
D. Career specialists	20	20.0	55.0	25.0	0.0	0.0	2.95
E. Rehabilitation programs	20	40.0	30.0	30.0	0.0	0.0	3.1
F. Community programs	20	25.0	45.0	30.0	0.0	0.0	2.95
G. Educational programs	20	25.0	40.0	35.0	0.0	0.0	2.9
H. Training programs	19	21.1	63.2	10.5	5.3	0.0	3.0
TOTAL	158	36.5	41.0	19.2	2.4	0.0	3.0

TABLE 21
Statistical Description of Responses to
Need u. "Familiarity with Communication Among Workers in Science Careers"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	40.0	40.0	15.0	5.0	0.0	3.15
B. Science industry	19	26.3	42.1	15.8	10.8	5.3	2.73
C. Science educators	20	10.0	45.0	40.0	0.0	5.0	2.55
D. Career specialists	20	0.0	45.0	50.0	5.0	0.0	2.4
E. Rehabilitation programs	20	30.0	35.0	30.0	5.0	0.0	2.9
F. Community programs	20	20.0	25.0	55.0	0.0	0.0	2.65
G. Educational programs	20	15.0	40.0	35.0	0.0	10.0	2.5
H. Training programs	18	33.3	16.7	38.9	5.6	5.6	2.66
TOTAL	157	21.7	36.3	35.0	3.8	3.2	2.69

TABLE 22
Statistical Description of Responses to
Need v. "An Appreciation of the Rich and Varied Lives that Scientists Lead"

RESPONDENT GROUP	N	Frequency of Responses (5)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	20.0	35.0	25.0	10.0	10.0	2.45
B. Science industry	19	10.5	21.1	42.1	15.8	10.5	2.05
C. Science educators	18	11.1	22.2	27.8	33.3	5.6	2.0
D. Career specialists	20	0.0	5.0	65.0	25.0	5.0	1.7
E. Rehabilitation programs	20	0.0	25.0	50.0	20.0	5.0	1.95
F. Community programs	20	5.0	20.0	50.0	25.0	0.0	2.05
G. Educational programs	20	5.0	30.0	40.0	15.0	10.0	2.05
H. Training programs	18	11.1	11.1	44.4	27.8	5.6	1.94
TOTAL	155	7.7	21.3	43.2	21.3	6.5	2.02

TABLE 23

Statistical Description of Responses to Need w. "An Opportunity to Assess their Interests, Assets, Abilities, and Needs Related to the Demands of a Science Career"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	70.0	10.0	20.0	0.0	0.0	3.5
B. Science industry	19	57.9	42.1	0.0	0.0	0.0	3.57
C. Science educators	20	45.0	40.0	15.0	0.0	0.0	3.3
D. Career specialists	20	70.0	30.0	0.0	0.0	0.0	3.7
E. Rehabilitation programs	20	60.0	25.0	15.0	0.0	0.0	3.45
F. Community programs	20	45.0	40.0	15.0	0.0	0.0	3.3
G. Educational programs	20	65.0	35.0	0.0	0.0	0.0	3.65
H. Training programs	19	57.9	26.3	15.8	0.0	0.0	3.42
TOTAL	158	58.9	31.0	10.1	0.0	0.0	3.48

TABLE 24

Statistical Description of Responses to Need x. "An Awareness of the Educational Opportunities in Science Preparation Beyond High School"

RESPONDENT GROUP	N	Frequency of Responses (%)					$\bar{X}$
		Much More	Some More	Some Less	Much Less	Not Need	
A. Deaf scientists	20	60.0	30.0	10.0	0.0	0.0	3.5
B. Science industry	19	63.2	36.8	0.0	0.0	0.0	3.63
C. Science educators	20	25.0	60.0	15.0	0.0	0.0	3.1
D. Career specialists	20	45.0	40.0	15.0	0.0	0.0	3.3
E. Rehabilitation programs	20	55.0	40.0	5.0	0.0	0.0	3.5
F. Community programs	20	35.0	40.0	25.0	0.0	0.0	3.1
G. Educational programs	20	30.0	65.0	5.0	0.0	0.0	3.25
H. Training programs	19	36.8	36.8	26.3	0.0	0.0	3.10
TOTAL	158	43.7	43.7	12.7	0.0	0.0	3.31